IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of: :

KUO et al. :

Application No.: 09/684,576 : Group Art Unit: 2827

Filing Date: October 6, 2000 : Examiner: Luan C. Thai

Title: ELECTRONIC COMPONENT AND METHOD OF MANUFACTURE

Commissioner for Patents
Washington, D.C. 20231

DECLARATION OF PRIOR INVENTION IN THE UNITED STATES OR IN A NAFTA OR WTO MEMBER COUNTRY TO OVERCOME CITED PATENT OR PUBLICATION (37 C.F.R. § 1.131)

PURPOSE OF DECLARATION

1. This declaration is to establish completion of the invention in this application in the United States, at a date prior to March 30, 2000, that is the effective date of the prior art:

☐ publication

☒ patent

that was cited by the

☒ examiner.

☐ applicant.

2. The persons making this declaration is (are):

☒ the inventors, a witness, and an attorney of the assignee.

☐ only some of the joint inventor(s)
(and a suitable excuse is attached for failure of the omitted joint inventor(s)

to sign)

☐ the party in interest.
(and a suitable explanation as why it is not possible to produce the declaration of the inventor(s) is attached)

FACTS AND DOCUMENTARY EVIDENCE

3. To establish the date of completion of the invention of this application, the following attached documents and/or models are submitted as evidence:

☐ sketches

☐ blueprints

☐ photographs

☒ reproduction(s) of notebook entries

☒ other documents

☒ supporting statement(s) by witness(es) (where verbal disclosures are the evidence relied upon

From these documents and/or models, it can be seen that the invention in this application was made

☐ on _____

☒ at least by the date of February 17, 2000, which is a date earlier than the effective date of the reference.

DILIGENCE

4. Attached is a statement establishing the diligence of the applicants, from the time of their conception, to a time just prior to the date of the reference, up to the:

☐ actual reduction to practice.

☒ filing of this application.

TIME OF PRESENTATION OF THE DECLARATION

5.

(a) ☒ This declaration is submitted prior to final rejection.

(b) ☐ This declaration is submitted with the first response after final rejection, and

is for the purpose of overcoming a new ground of rejection or requirement made in the final rejection.

(c) ☐ This declaration is submitted after final rejection. A showing under 37 C.F.R. § 1.116(b) is submitted herewith.

DECLARATION

6. As a person signing below:

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

SIGNATURES

7.

A. Inventor(s)

Full name of sole or first inventor: Shun-Meen Kuo

Inventor's signature: Shun-Meen Kuo Date: December 17, 2002
Country of Citizenship: United States
Residence: 5943 West Gary Drive, Chandler, AZ 85226
Post Office Address: Same as above

Full name of second joint inventor: Darrel Richard Frear

Inventor's signature: [signature] Date: December 17, 2002
Country of Citizenship: United States
Residence: 14248 South 12th Street, Phoenix, AZ 85048
Post Office Address: Same as above

B. Witness

Full name of witness: Jaynal Abedin Molla

Witness's signature: Jaynal Abedin Molla Date: Dec. 17, 2002

Post Office Address: 897 W. Laredo Ave. Gilbert, AZ 85233

C. Patent Attorney

Full name of patent attorney: George C. Chen

Patent Attorney's signature: [signature] Date: 20 December 2002
Post Office Address: Two North Central Avenue, Suite 2200, Phoenix, AZ 85004

Respectfully submitted,

12/24/02
Date

BRYAN CAVE LLP

[signature]
Kenneth A. Nelson
Registration No. 48,677
Two North Central Avenue, Suite 2200
Phoenix, Arizona 85004
Telephone: (602) 364-7000
Fax: (602) 364-7070

CERTIFICATE OF EXPRESS MAILING

I hereby certify that this document (and any as referred to as being attached or enclosed) is being deposited with the United States Postal Service as "Express Mail Post Office to Addressee" service, mailing label No. **EL452289782US** on **December 24, 2002** and addressed to Commissioner for Patents, Washington, D.C. 20231.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Printed Name: Thomas LaVance

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of: :

KUO et al. :

Serial No.: 09/684,576 : Group Art Unit: 2827

Filed: October 6, 2000 : Examiner: Luan C. Thai

For: ELECTRONIC COMPONENT AND METHOD OF MANUFACTURE

EXHIBIT A

TIMELINE

"On-Or-About" Date	Event
February 17, 2000	Shun-Meen Kuo and Darrel Richard Frear conceive of the invention for the subject patent application. (See Exhibit B, ¶ 2 and Exhibit C, ¶ 2.)
February 17, 2000	Shun-Meen Kuo records a portion of the invention in his inventor notebook on pages 41 and 42, shows and explains his notes regarding the invention to Darrel Frear, and has Darrel Frear sign and date pages 41 and 42 of the inventor notebook showing that he has read and understood the notes on those pages regarding the invention. (See Attachment B1 and Exhibit B, ¶ 3.)
February 25, 2000	Shun-Meen Kuo records another portion of the invention, including drawings, on pages 43-46 of his inventor notebook, shows and explains his notes regarding the invention to Darrel Frear, and has him sign and date pages 43-46 of the inventor notebook showing that he has read and understood the notes on those pages regarding the invention. (See Attachment B3 and Exhibit B, ¶ 4.)

February 25, 2000	Shun-Meen Kuo shows and explains his notes regarding the invention from pages 41-46 of his inventor notebook to Motorola employees Jaynal Abedin Molla and Yifan Guo and has them sign and date pages 41-46 of his inventor notebook showing that they have read and understood the notes on those pages regarding the invention. (See Attachments B1 and B3 and Exhibit B, ¶ 5.)
February 25, 2000	Jaynal Molla reads and understands the invention disclosure recorded on pages 41-46 of Shun Meen Kuo's inventor notebook, discusses that disclosure with Shun-Meen Kuo and Darrel Frear, and signs and dates pages 41-46 of Shun Meen Kuo's inventor notebook indicating his understanding of the disclosure. (See Attachments B1 and B3 and Exhibit D, ¶ 2).
February 25, 2000	Shun-Meen Kuo and Darrel Frear submit a patent disclosure for the invention to the Motorola patent committee. (See Attachment B2, Exhibit B, ¶ 6, and Exhibit C, ¶ 3.)
April 10, 2000	Shun-Meen Kuo and Darrel Frear design a test wafer for the invention packaging. (See Attachment B4, Exhibit B, ¶ 7, and Exhibit C, ¶ 4.)
April 17, 2000	Shun-Meen Kuo and Darrel Frear continue to work on the design of the test wafer. (See Attachment B5, Exhibit B, ¶ 8, and Exhibit C, ¶ 5.)
April 17, 2000	The invention disclosure (#SC11259ZP) is assigned to the process committee. (See Attachment B5, Exhibit B, ¶ 9, and Exhibit C, ¶ 6.)
April 24, 2000	Shun-Meen Kuo and Darrel Frear continue to work on the design of the test wafer. (See Attachment B6, Exhibit B, ¶ 10, and Exhibit C, ¶ 7.)
April 24, 2000	The date of the invention disclosure presentation is set for May 11, 2000. (See Attachment B6, Exhibit B, ¶ 11, and Exhibit C, ¶ 8.)
May 11, 2000	Shun-Meen Kuo and Darrel Frear present the invention disclosure to the patent committee. (See Attachment B7, Exhibit B, ¶ 12, and Exhibit C, ¶ 9.)

June 19, 2000	Shun-Meen Kuo and Darrel Frear receive word that the patent committee has made a decision to pursue filing. (See Attachment B8, Exhibit B, ¶ 13, and Exhibit C, ¶ 10).
June 23, 2000	George C. Chen receives from Motorola, Inc. a disclosure # SC11259ZP regarding the above identified invention. (See Attachment E1 and Exhibit E, ¶ 2.)
July 11, 2000	Shun-Meen Kuo and Darrel Frear meet with George Chen to review the invention disclosure in preparation for the preparation and filing of a patent application. (See Exhibit B, ¶ 14, Exhibit C, ¶ 11, and Exhibit E, ¶ 3.)
July, August, and September, 2000	George Chen works on the patent application. (See Exhibit E, ¶ 4.)
September 7, 2000	George Chen sends a draft of the patent application to the inventors for their review. (See Attachment E2 and Exhibit E, ¶ 5.)
September 7, 2000	Shun-Meen Kuo and Darrel Frear receive from George Chen a draft of the patent application for their review. (See Exhibit B, ¶ 15 and Exhibit C, ¶ 12.)
September 20, 2000	Shun-Meen Kuo reviews a draft of the patent application and provides George Chen with his comments and corrections. (See Exhibit B, ¶ 17.)
September 20, 2000	Shun-Meen Kuo and Darrel Frear sign a letter from George Chen indicating their understanding of the requirement to disclose relevant facts of which they have knowledge concerning the invention. (See Attachment B9, Exhibit B, ¶ 16, and Exhibit C, ¶ 13.)
September 25, 2000	George Chen receives comments from Shun-Meen Kuo regarding changes to the patent application, reviews and revises the patent application accordingly, and transmits the patent application to Motorola. (See Attachment E3 and Exhibit E, ¶ 6).

October 3, 2000	Shun-Meen Kuo and Darrel Frear execute a declaration pertaining to the patent application. (See Attachment B10, Exhibit B, ¶ 18, and Exhibit C, ¶ 14.)
October 6, 2000	The patent application is filed with the United States Patent and Trademark Office. (See Attachment A1.)

Attachment A1

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
UTILITY PATENT APPLICATION TRANSMITTAL LETTER

Attorney Docket No.: SC11259ZP

Mailing Date: October 6, 2000
Express Mailing Label No.: EJ140606737US

To: Assistant Commissioner for Patents
Box Patent Application
Washington D.C., 20231

Dear Sir:

Transmitted herewith for filing under 37 C.F.R. 1.53(b) is a:

☒ New Nonprovisional Utility Patent Application; or

☐ Continuation; or ☐ Divisional; or ☐ Continuation-In-Part (CIP); of prior US Application No. _____, filed on _____, having U.S. Examiner _____, in Group Art Unit _____

Of: Shun-Meen Kuo and Darrel R. Frear

For: ELECTRONIC COMPONENT AND METHOD OF MANUFACTURE

☒ 6 sheets of INFORMAL drawings and 27 pages of specification and claims.

☒ Newly executed oath or declaration combined with Power of Attorney on 2 pages.

☐ Copy of oath or declaration from prior U.S. application serial no. _____
☐ The following named inventor(s) from the prior application are hereby deleted from this application in accordance with 37 C.F.R. 1.63(d)(2) and 1.33(b): _____.

☐ Foreign priority to EPO patent application having serial number _____ and a filing date of _____, is hereby claimed under 35 USC 119.

☒ An Assignment Transmittal Letter and Assignment of the invention to Motorola, Inc.

☒ An Information Disclosure Statement (IDS), with PTO-1449, and 14 citation copies.

☒ Return Receipt Postcard.

☐ Preliminary Amendment.

☐ Please cancel pending claims _____.

☐ Incorporation by Reference (for Continuation/Division/CIP application). The entire disclosure of the prior application, from which a copy of the oath or declaration is supplied, is considered as being part of the disclosure of the accompanying application and is hereby incorporated by reference therein. Since the present application is based on a prior US application, please amend the specification by adding the following sentence before the first sentence of the specification:

"The present application is based on prior US application No. _____, filed on_____ _____, which is hereby incorporated by reference, and priority thereto for common subject matter is hereby claimed."

☐ Applicant hereby petitions pursuant to 37 C.F.R. §1.136(a) for a _____ month extension of time for response to the outstanding Official Action mailed _____. The period for response was previously set to elapse _____, and is accordingly hereby extended to _____, which is still within the six-month statutory period for response (35 U.S.C. § 133) which elapses _____. The reason for this petition is that a Division, Continuation, or CIP is being filed, and it is desired to maintain the present application in pending condition pursuant to 35 USC § 120 through at least the filing of the Division, Continuation, or CIP application. The required Extension Fee established by 37 C.F.R. § 1.17(a) pursuant to 35 U.S.C. § 41(a) (8) is:

EXTENSION	FEE
☐ First Month	$110.00
☐ Second Month	$390.00
☐ Third Month	$890.00
☐ Fourth Month	$1,390.00
☐ Fifth Month	$1,890.00

☒ The filing fee is calculated as follows:

CLAIMS AS FILED, LESS ANY CANCELED BY AMENDMENT

FOR	NUMBER OF CLAIMS	NUMBER EXTRA	RATE		FEE
TOTAL CLAIMS	26 - 20 =	6	x $18	=	$108.00
INDEPENDENT CLAIMS	3 - 3 =	0	x $80	=	$ 0.00
MULTIPLE DEPENDENT CLAIMS			$270	=	$ 0.00
BASIC FEE				=	$ 710.00
TOTAL FILING FEE				=	$ 818.00

☒ Please charge Deposit Account No. 13-4771 in the amount of $ 818.00 for the Total Filing Fee, and the Extension Fee under 37 C.F.R. §1.136(a), if applicable.

☒ The Commissioner is hereby authorized to charge any additional fees which may be required now or in the future during the entire pendency of this application under 37 C.F.R. 1.16 or 37 C.F.R. 1.17, including any present or future time extension fees which may be required, or credit any overpayment to Deposit Account No. 13-4771.

☒ This sheet is submitted in **duplicate**.

This transmittal letter has 2 total pages.

10-05-'00
DATE

Charles W. Bethards 36,453
Charles W. Bethards REG. NO.

Motorola, Inc.
Customer Number: 23330

Attorney of Record
Telephone No.: (480) 441-4237
Facsimile No.: (480) 441-5220

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of: :

KUO et al. :

Serial No.: 09/684,576 : Group Art Unit: 2827

Filed: October 6, 2000 : Examiner: Luan C. Thai

For: ELECTRONIC COMPONENT AND METHOD OF MANUFACTURE

EXHIBIT B

STATEMENT ESTABLISHING DILIGENCE

I, Shun Meen Kuo, declare that:

1. I am an employee of Motorola, Inc., and I am a co-inventor of the subject matter described in the patent application identified above and claimed in claims 1-26 therein;
2. On or prior to February 17, 2000, my co-inventor, Darrel Richard Frear, a Motorola employee, and I conceived of the idea of the electronic component and method of manufacture as disclosed and claimed in the above-identified application;
3. On or about February 17, 2000, I recorded the invention in my inventor notebook on pages 41 and 42, showed and explained my notes regarding the invention to Darrel Frear, and had him sign and date pages 41 and 42 of my inventor notebook showing that he had read, understood, and approved my notes on those pages regarding the invention (see Attachment B1);

4. On or about February 25, 2000, I recorded some further ideas regarding the invention, including drawings, on pages 43-46 of my inventor notebook, showed and explained my notes regarding the invention to Darrel Frear, and had him sign and date pages 43-46 of my inventor notebook showing that he had read, understood, and approved my notes on those pages regarding the invention (see Attachment B3);
5. On or about February 25, 2000, I showed and explained my notes regarding the invention from pages 41-46 of my inventor notebook to Motorola employees Jaynal Abedin Molla and Yifan Guo and had them sign and date pages 41-46 of my inventor notebook showing that they had read and understood my notes on those pages regarding the invention (see Attachments B1 and B3);
6. On or about February 25, 2000, Darrel Frear and I submitted a patent disclosure for the invention to the Motorola patent committee (see Attachment B2);
7. On or about April 10, 2000, Darrel Frear and I designed a test wafer for the invention packaging (see Attachment B4);
8. During the week of April 17, 2000, Darrel Frear and I continued to work on the design of the test wafer (see Attachment B5);
9. During the week of April 17, 2000, the Motorola patent committee informed Darrel Frear and me that the invention disclosure (#SC11259ZP) was assigned to the process committee (see Attachment B5);
10. During the week of April 24, 2000, Darrel Frear and I continued to work on the design of the test wafer (see Attachment B6);

11. During the week of April 24, 2000, the Motorola patent committee informed Darrel Frear and me that the date of the invention disclosure presentation was set for May 11, 2000 (see Attachment B6);
12. On or about May 11, 2000, Darrel Frear and I presented the invention disclosure to the patent committee (see Attachment B7);
13. On or about June 19, 2000, the Motorola patent committee informed Darrel Frear and me that it had decided to file the invention disclosure (see Attachment B8);
14. On or about July 11, 2000, Darrel Frear and I met with George C. Chen to review the invention disclosure in preparation for the preparation and filing of a patent application (see Attachment E2);
15. On or about September 7, 2000, I received from George Chen a draft of the patent application for my review;
16. On or about September 20, 2000, I signed a letter from George Chen indicating my understanding of the requirement to disclose relevant facts of which I have knowledge concerning the invention (see Attachment B9);
17. On or about September 20, 2000, I reviewed a draft of the patent application and provided George Chen with my comments and corrections; and
18. On or about October 3, 2000, I executed a declaration pertaining to the patent application (see Attachment B10).

December 17, 2002
Date

Shun-Meen Kuo
Shun Meen Kuo

Attachment B1

2/17/00 Wafer Level MEMS Switch Packaging MEMS Switch 41

Wafer Level MEMS Packaging

The proposed is a packaging concept that allows wafer level packaging of MEMs devices. The potential benefit is the concept eliminates the difficult task of die handling and saves significant die space. The proposed concept also provides a self alignment mechanism that gives relief to the strict tolerances required for die attach and wire bonding for high frequency applications.

A micro-electrical mechanical system (MEMs) device consists of very small mechanical devices that are actuated by electrical signals. These devices are sensitive and must be hermetically packaged.

The current packaging process involves dicing a wafer then "pick and place" the die into individual packages held in a fixture. The die is then attached to the package and electrically connected to the package leadframe by wire bonding. The final stage of MEMs processing occurs after the die is attached to the package. The active component of the MEMs device must be released from its polymer encapsulant to become free moving. The device is released by placing the package into a plasma-etch chamber. The gas plasma etches the polymer to release the active component. Once released, the active component of the MEMs device is free standing and can be easily damaged by mishandling. To isolate the MEMs device, a lid is hermetically attached to the package.

The proposed packaging process reduces die handling and improves process time by performing more steps at the wafer level rather than on singulated die. The proposed processing is as follows:

1. Complete die fabrication by adding additional metal layers for solder interconnect and package joining. The die surface will have bond pads and sealing rings that are metallized for electrical and mechanical attachment.
2. The package housing is fabricated with sealing rings and through vias with pads at both sides. The inside pads are connected to the die; the pads on the outside of the package are used to attach the package for board level assembly.
3. The MEMs device is released in a wafer-level process using plasma etch.
4. Solder materials (or epoxy materilas) are deposited on the wafer metallized pads and the package metallized pads. The flip chip solder bumps on the wafer have sufficient height to offer clearance for the active MEMs component.
5. Electrical testing of devices is performed at wafer level.
6. The individual package housings are aligned and placed on the wafer.

2/25/2000 Jaynal A. Molla 2/25/00

2/17/00 2/17/00

2/17/00 2/17/00

2/17/00 2-25-2000

Jaynal A. Molla 2/25/00

1/7/00 Wafer level MEMS switch packaging MEMS switch 42

7. The wafer/package assembly is processed in a controlled atmosphere furnace and processed at such temperatures to result in reflow and joining of the electrical interconnects on the die and the hermetic die/package seal.
8. Ball grid array (BGA) solder balls are then placed on the package and reflowed in a standard furnace. (Note: the choice of solder alloy for flip chip solder interconnects and hermetic package seal can have a melting temperature that is in excess of the BGA solder process temperature to prevent reflow of the hermetic and flip chip joints).
9. The packages are then singulated by wafer saw.

Releasing the active MEMs devices at the wafer-level and singulating the die after packaging eliminates handling issues of small die with sensitive MEMS devices. By using flip chip packaging, the size of the package is only slighter larger than the die and much smaller than a wire bonded package. Furthermore, solder interconnects have lower inductance and allows self-alignment of the package to the die (in process step 6). Thus the effect of inductance is lowered and the requirement of precise wire bond length control is eliminated.

Details:

Flux process: The flip chip and hermetic seal joints must be performed in a fluxless environment so as to not detrimentally affect MEMs performance. A fluxless process (such as PADs) will be determined.
Gap control: Package standoff is determined by the solder bump height on the flip chip joints and the hermetic seal joint. These will be optimized through solder deposition control.
Solder hierarchy and pad metallurgy – will be determined through studies.
Solder Application – The methods of applying the solder to the package requires study (physical or electrochemical).

2/25/00 2/17/00
Jaynal A. Molla 2/25/00 2/17/00

2/17/00 2/25/00
2/17/00 Jaynal A. Molla 2/25/00

Attachment B2

MOTOROLA INNOVATION DISCLOSURE

Disclosure Number : SC11259ZP **Disclosure Date :** 05-APR-2000

Submitted To : Process-PHX

Innovation Name : Wafer Level MEMS Switch Packaging

Innovation Description : The proposed is a packaging concept that allows wafer level packaging of MEMs switches. The potential benefit is that the concept eliminates the difficult task of die handling and saves significant die space. The proposed concept also provides a self alignment mechanism that gives relief to the strict tolerances required for die attach and wire bonding for high frequency applications. Being a wafer level process, many devices can be packaged together and the through put will be significantly improved.

Has your idea been disclosed or is already known outside of Motorola : NO

Has a product incorporating your idea been sold, offered for sale, placed in production, qualification, sampled, described in any publication (including Motorola promotional literature), marketed, shipped to anyone outside of Motorola (customer or distributor), or placed into inventory (e.g. die bank, wafer bank, etc)? : NO

What is the earliest verifiable date that you communicated your idea to an individual that is NOT an inventor (e.g., the date a non-inventor witness signed your engineering notebook) : 09-FEB-2000

Was your idea created or developed through a consortium, aliance, government contract, or joint venture : NO

Innovator Name : SHUN MEEN KUO	**Social Security Number :** 297-78-7026
Commerce ID : 10021025	**Badge :** YSS5
Department Number : RM536	**Mail Drop :** AZ34-EL725
Business Unit : DDL - Digital DNA Laboratories	**Sector :** SPS-DDL
Phone : +1(480)413-5664	**Email :**R10875@email.mot.com
Fax : +1(480)413-4511	**Citizenship :** USA
Residential Address :	
Street Address	5943 W Gary Drive
City, State Zip	Chandler, AZ 85226
Company Name :	Motorola
Mailing Address :	
Street Address	2100 E Elliot Road
City, State Zip	Tempe, AZ 85284

Disclosure Status

Witness 1 :
Witness1 Acknowledge Date : 24-APR-2000
Witness1 Signed and dated engineering notebook : YES
Witness1 Comments / Feedback :

Witness 2 :
Witness2 Acknowledge Date : 24-APR-2000
Witness2 Signed and dated engineering notebook : YES
Witness2 Comments / Feedback :

Manager :
Manager Accept Date : 25-APR-2000
Manager Comments / Feedback :
Docket Number : SC11259ZP
Docket Number Assign Date : 25-APR-2000
Patent Administrator :

Date: Feb. 28, 2000
To: Darrel Frear
CC: Distribution

From: Shun-Meen Kuo

Phone: (602) 413-5664

Subject: Weekly Report (2/21-2/25, 2000)

REDACTED

REDACTED

RF Material:
ACF on RF

REDACTED

RF-MEMS Project:

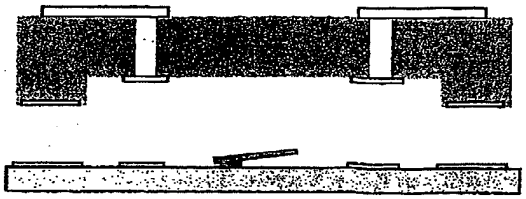
- Received a test wafer to test the dicing capability in ISL. Short-term solution with existing capabilities at Bldg. 90 has been proposed. Time and resource allocation needs be finalized by the management. (AD)
- Wafer level packaging has been considered as the long-term solution and details were discussed. A pattern disclosure was submitted on 2/25.

REDACTED

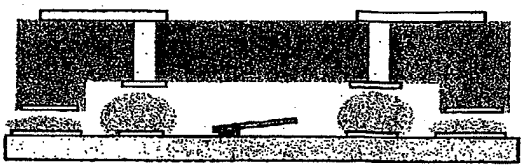
Attachment B3

2/17/00 Wafer level MEMS Switch packaging MEMS Switch 43

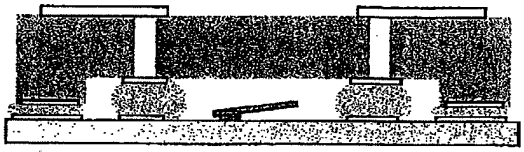
Process Flow



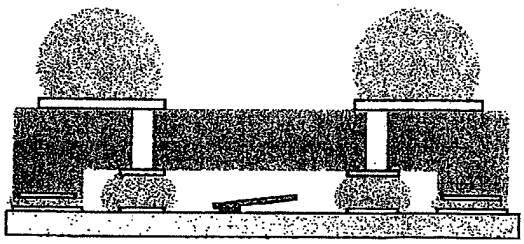
Device & Package



Solder dispense and die attachment



Solder reflow and seal



Solder ball attachment

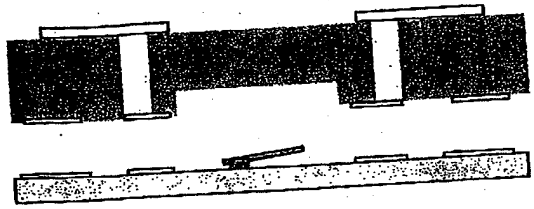
Shu-Meen Kuo 2/25/00
Daniel Tan 2/25/00

Daynal A. Molla 2/25/00

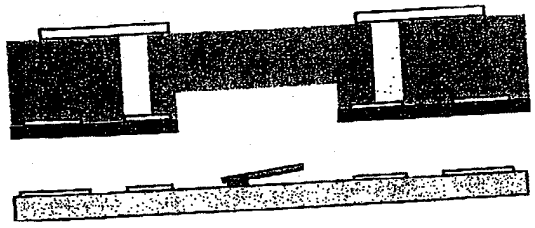
Shu-Meen Kuo 2/25/00
Daniel Tan 2/25/00

Daynal A. Molla 2/25/00

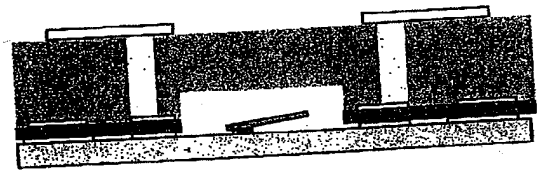
Process Flow II



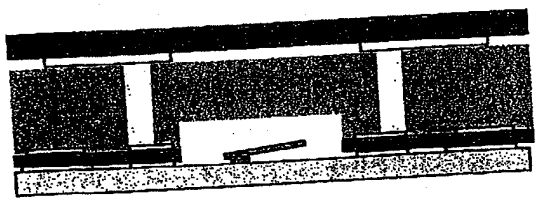
Device & Package



Solder or SMK 2/25/00
Anisotropic conductive film (ACF) attachment



Die attach and seal



Solder or SMK 2/25/00
Anisotropic conductive film (ACF) attachment

Daisnal A. Molla 2/25/00

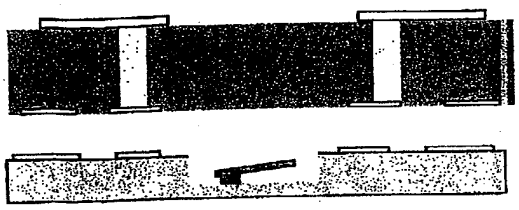
Shin-Meen Kuo 2/25/00
Daniel Tan 2/25/00

Shin-Meen Kuo 2/25/00
Daniel Tan 2/25/00

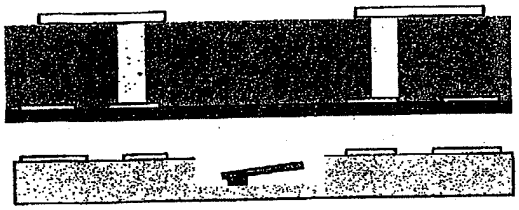
Daisnal A. Molla 2/25/00

Daisnal A. Molla 2/25/00

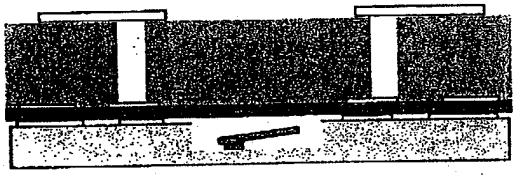
Process Flow III



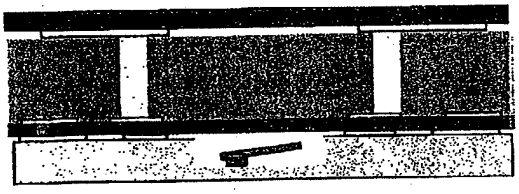
Device and package



Solder or Anisotropic conductive film (ACF) attachment



Die attach and seal



Solder or Anisotropic conductive film (ACF) attachment

Shu-Men Kuo 2/25/00
Daniel Liu 2/25/00

Jaynal A. Molla 2/25/00

Shu-Men Kuo 2/25/00
Daniel Liu 2/25/00

Jaynal A. Molla 2/25/00

2/25/00
2/25/00

Several other modified versions of the concept are also presented:

In process flow II, the contact pads for electrical interconnections and sealing are at the same level. With this configuration, same amount of the solder can be applied to both pads and reduced process steps. The solder can also be replaced with adhesive materials if the material can hold the hermitic requirement of the package. Also, glass seals could be used to join the package to the silicon.

In process flow III, the entire package portion is flat while the switch is sited in a cavity in the wafer. In this format, applied adhesive film to the package becomes a simpler operation

The package can be in individual format of in a plate (wafer) format. With the plate format, the whole wafer can be attached to the package plate and sealed together.

Passive components needed such as capacitor or inductor can be integrated into the package and formed a completed functional circuit in the single package.

This concept will not be limited to only MEMS switches and can applied to other device to reduce packaging time, package size and interconnect inductance.

Shu-Men Kuo 2/25/00 Daniel Kuo 2/25/00 Daynal A. Molla 2/25/00

Shu-Men Kuo 2/25/00 Daniel Kuo 2/25/00 Daynal A. Molla 2/25/00

Attachment B4

Date: April 18, 2000
To: Darrel Frear
CC: Distribution

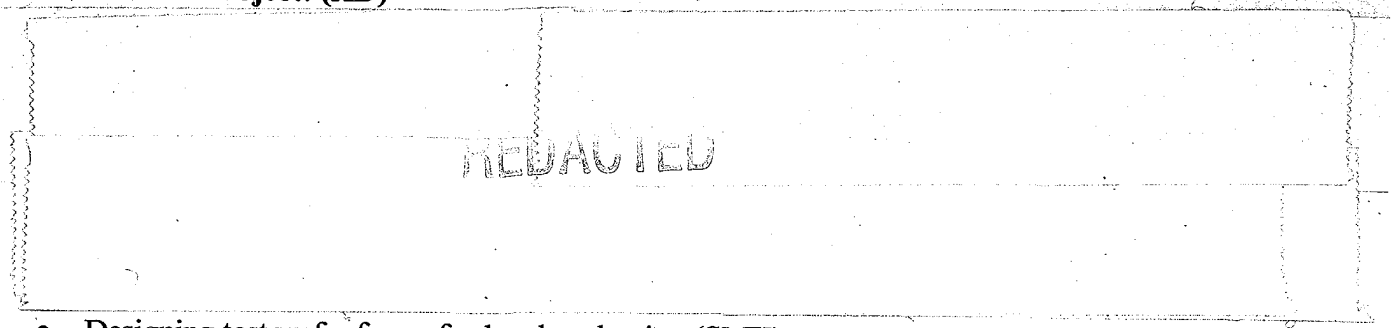
From: Shun-Meen Kuo

Phone: (602) 413-5664

Subject: Weekly Report (4/10-4/14, 2000)

REDACTED

RF-MEMS Project: (AD)



- Designing test wafer for wafer-level packaging (SMK)

REDACTED

Attachment B5

Date: April 25, 2000
To: Darrel Frear
CC: Distribution

From: Shun-Meen Kuo

Phone: (602) 413-5664

Subject: Weekly Report (4/17-4/21, 2000)

REDACTED

RF-MEMS Project: (AD)

REDACTED

- Continue design of wafer level packaging test wafer. (SMK)
- Wafer level packaging disclosure (#SC11259ZP) has been assigned to process committee.(SMK)

REDACTED

Attachment B6

Date: May 2, 2000
To: Darrel Frear
CC: Distribution

From: Shun-Meen Kuo

Phone: (602) 413-5664

Subject: Weekly Report (4/24-4/28, 2000)

REDACTED

REDACTED

RF-MEMS Project: (AD)

REDACTED

- Test wafer design for wafer level packaging continues. The disclosure presentation is set on May 11th.

REDACTED

Attachment B7

Date: May 16, 2000
To: Darrel Frear
CC: Distribution

From: Shun-Meen Kuo

Phone: (602) 413-5664

Subject: Weekly Report (5/8-5/12, 2000)

REDACTED

REDACTED

RF-MEMS Project: (AD,RL)

REDACTED

- Presented disclosure "Wafer level MEMs switch packaging" (#SC11259ZP). Since a very similar disclosure was presented a few months ago, the committee will review the content further and make final decision.(DF,SMK)

REDACTED

SC1125421

Wafer Level MEMS Switch Packaging

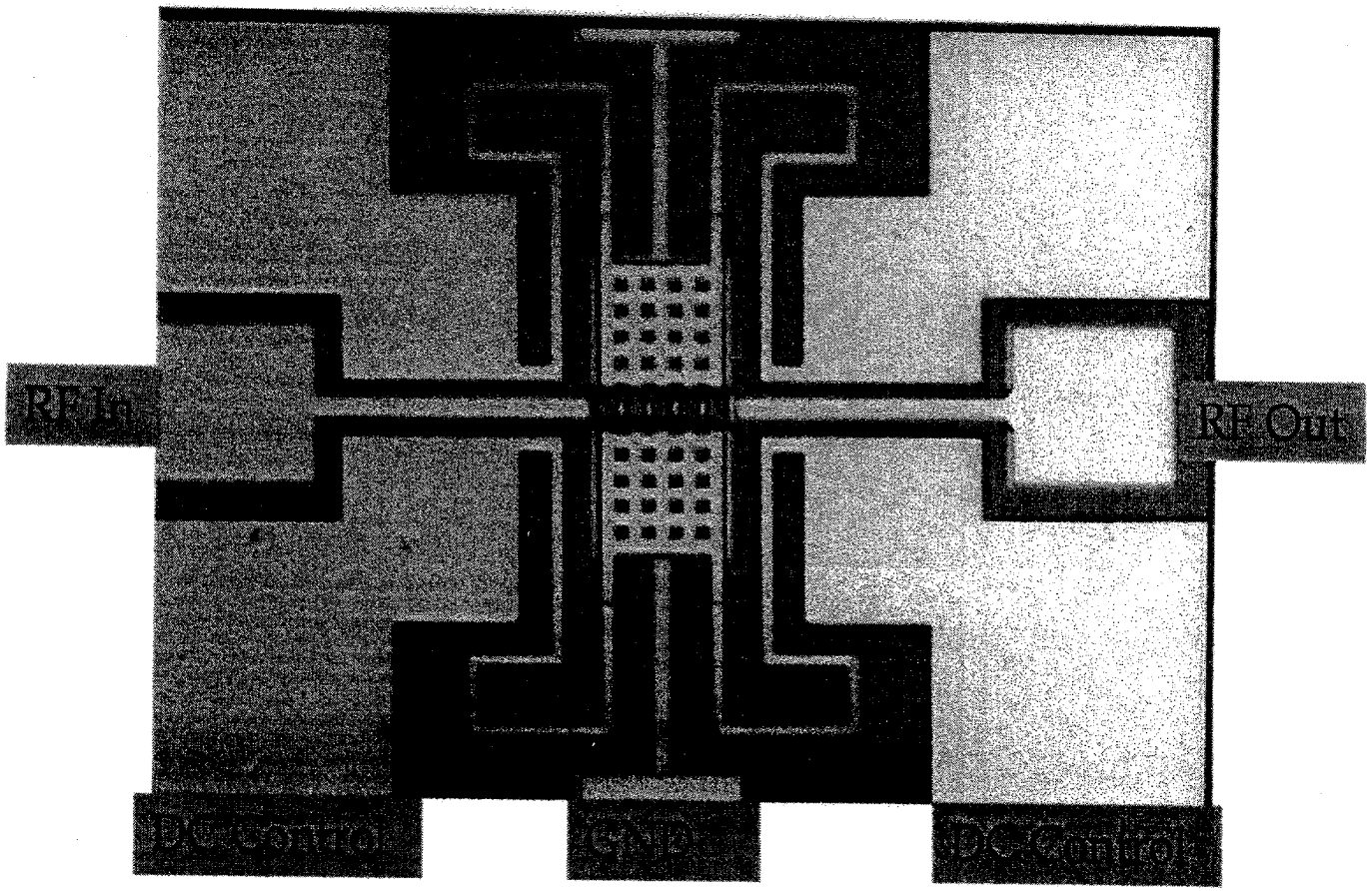
Shun-Meen Kuo
Darrel Frear

Advantages of MEMS Switch:

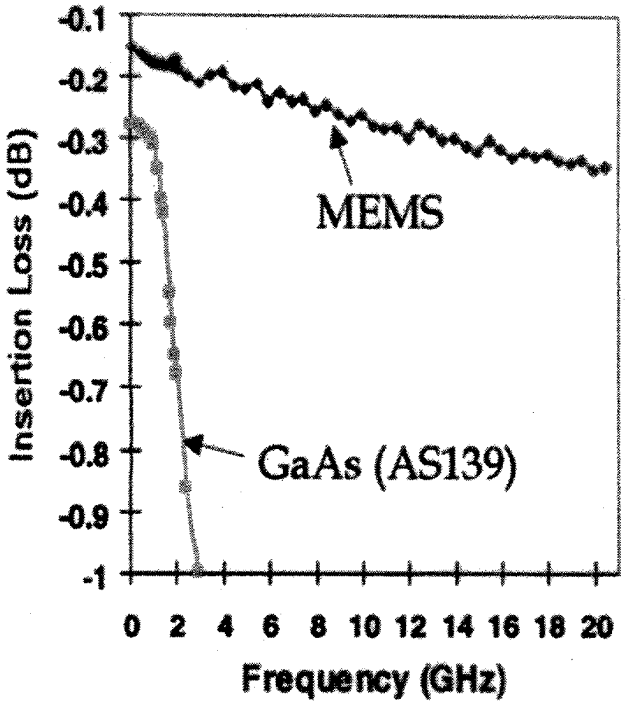
(1) Low insertion loss: - 0.3dB at 20 GHz

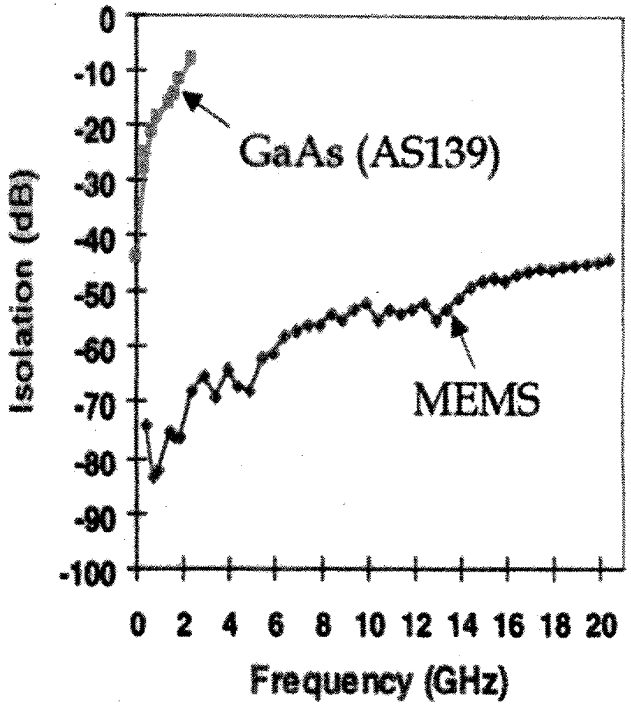
(2) Excellent isolation: -40 dB at 20 GHz

Folded spring RF switch (I)



MEMS vs. GaAs switch





Potential Customers:

Motorola/CE, cell phone, antenna manufactures

Projected Market for MEMS Switch:

Market	2001	2002	2003	2004	2005	2006
Cellular	30	28,300	195,800	313,200	400,600	492,800
Antenna	20	33,000	286,000	550,000	880,000	1,100,000
Other Relay	0	0	8,500	15,000	25,000	40,000

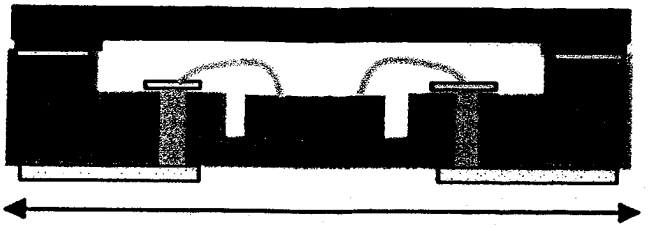
Values for units are in thousands

Competition on MEMS switch:

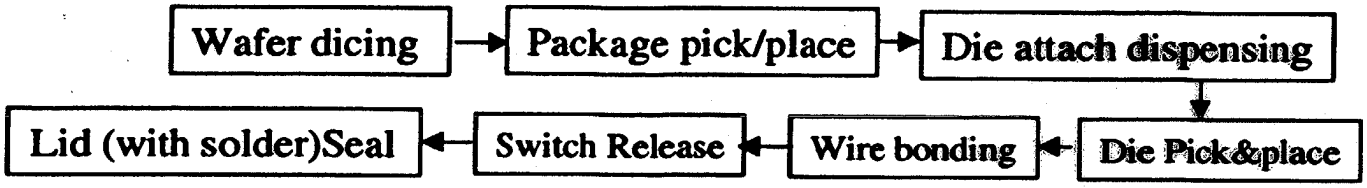
Rockwell:
-Cantilever resistive type switches
-Most mature device/process for DAPA
-No commercial packaging solutions available
TI:
-Expertise in digital mirror display (DMD)
-Membrane capacitive switches
MCNC
-Micro-relay with good performance
-Low speed using thermal actuation
Raytheon/Hughues
-Reinforced by TI defense purchase
-Have high Q3-D inductors

Wire Bond Package

Current Single Wire Bond Package

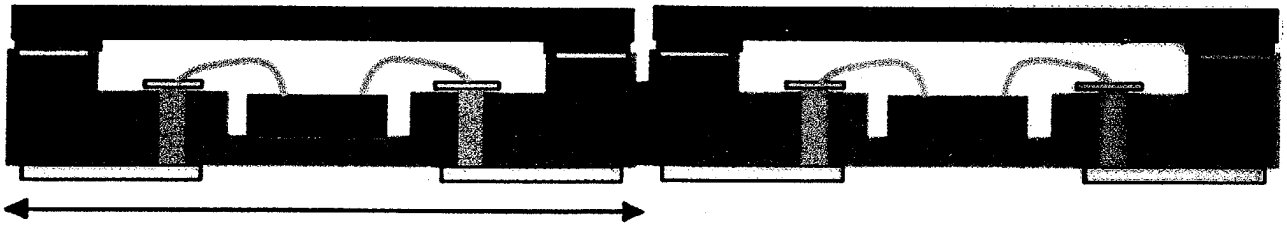


4 mm

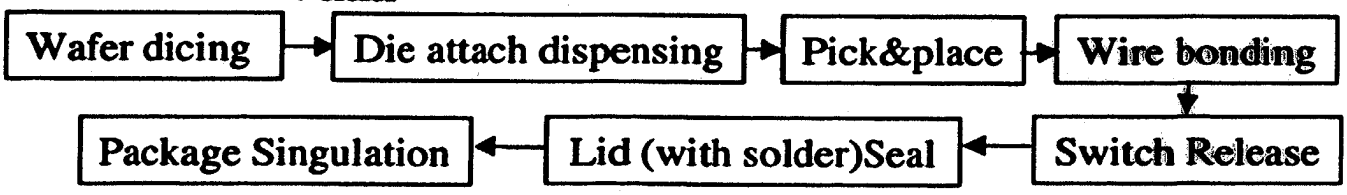


Proposed Array Wire Bond Package

(with package housing in array format)



4 mm

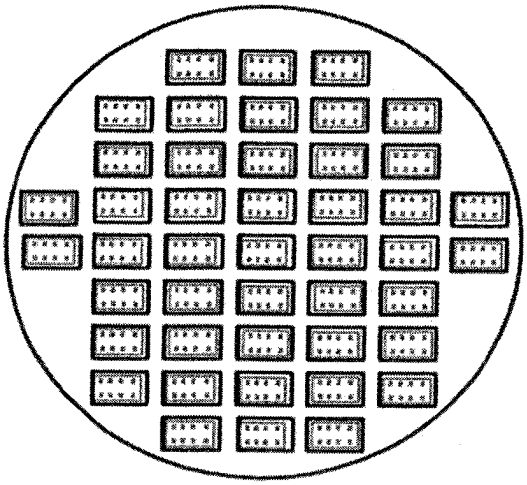


Process Concerns:

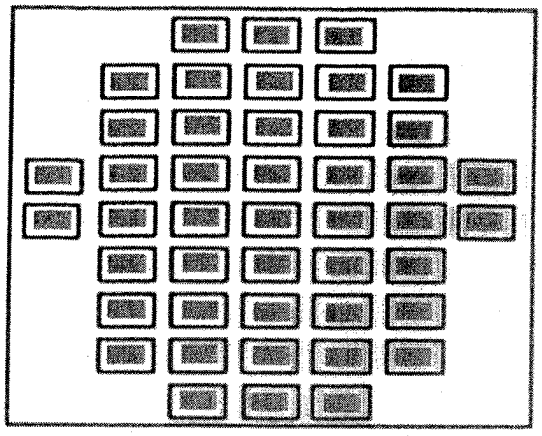
(1) Throughput
(2) Die handling
(2) Die placement accuracy
(3) Wire bond inductance

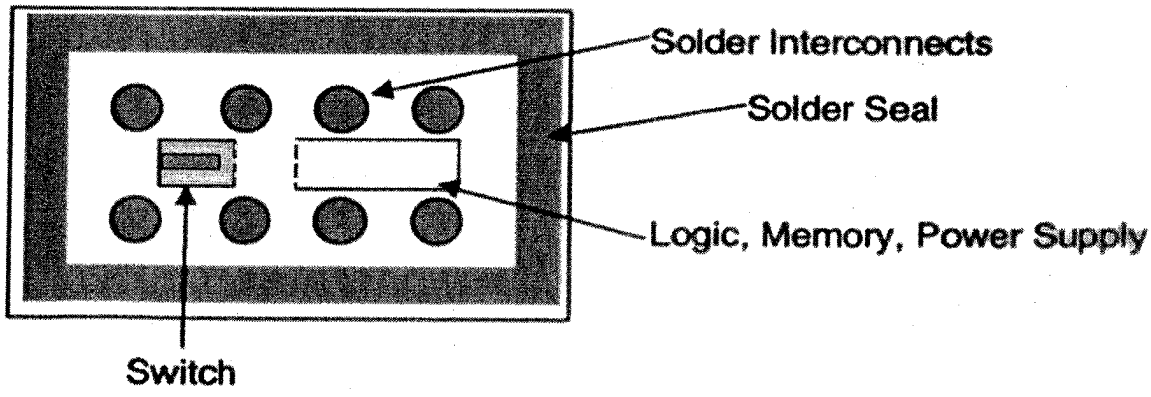
Wafer Level Packaging

Wafer with Switches/Devices

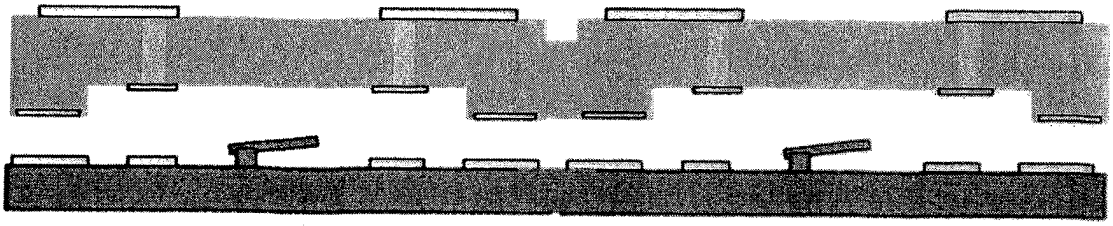


Array Ceramic Package

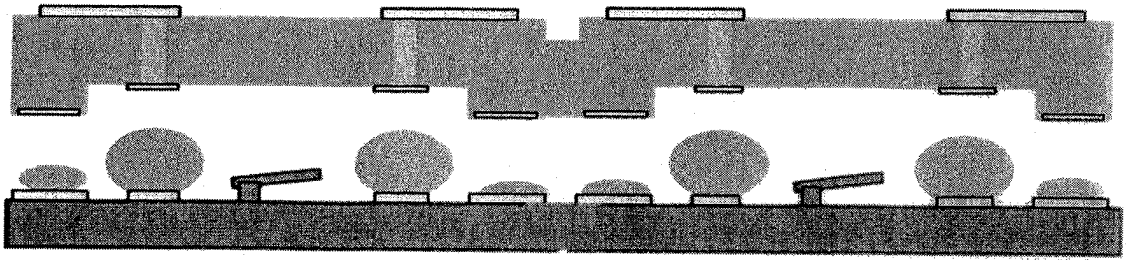




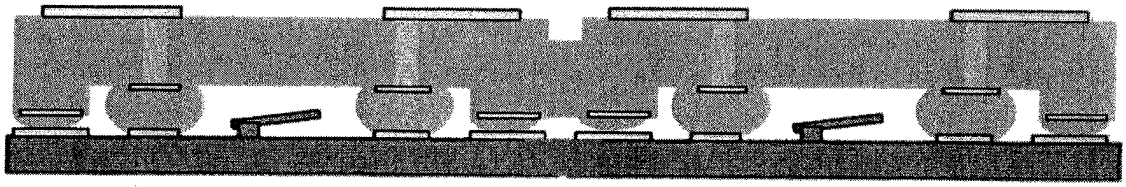
Process Flow I



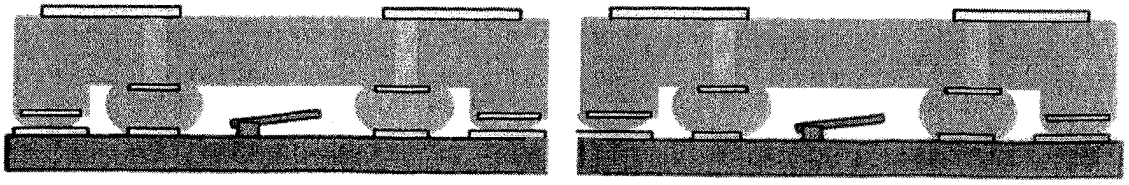
Device & Package



Solder Dispense

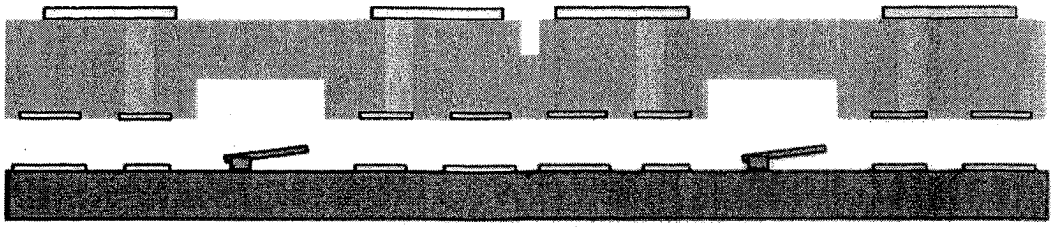


Die Attach and Reflow

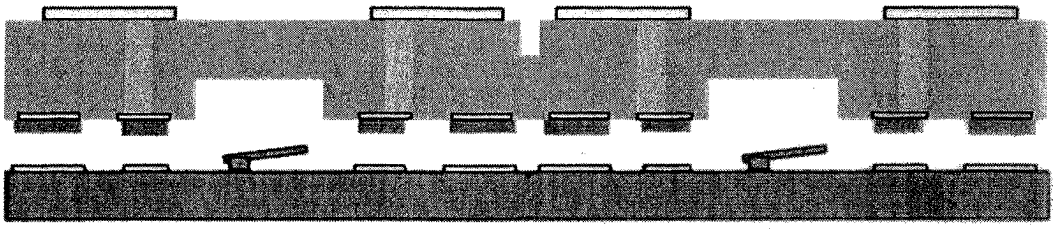


Singulation

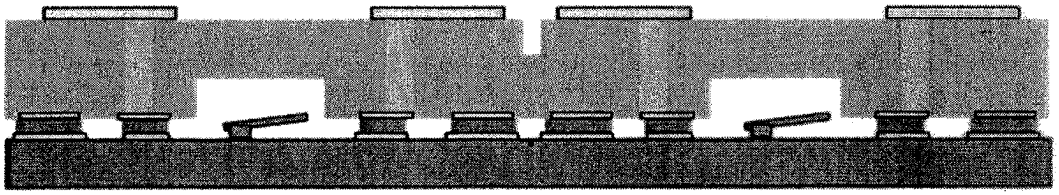
Process Flow II



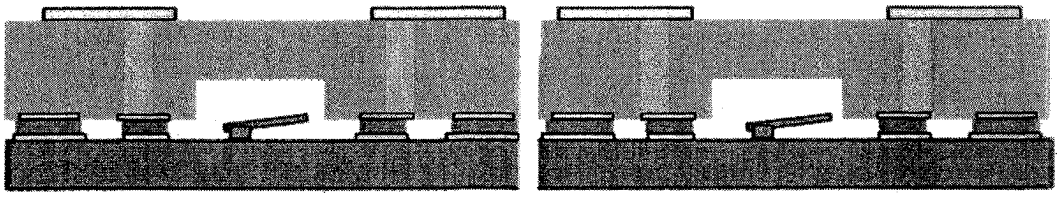
Device and package



Solder printing

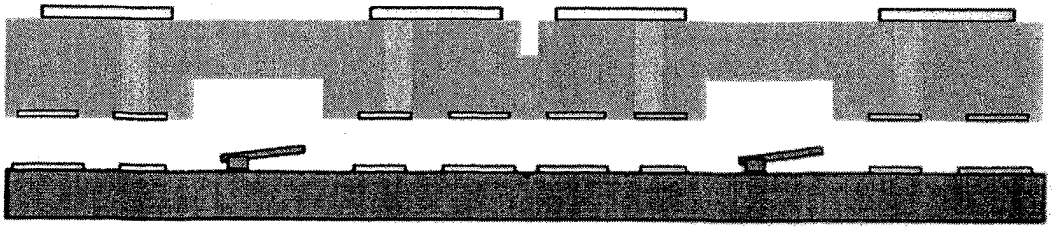


Die attach and Reflow

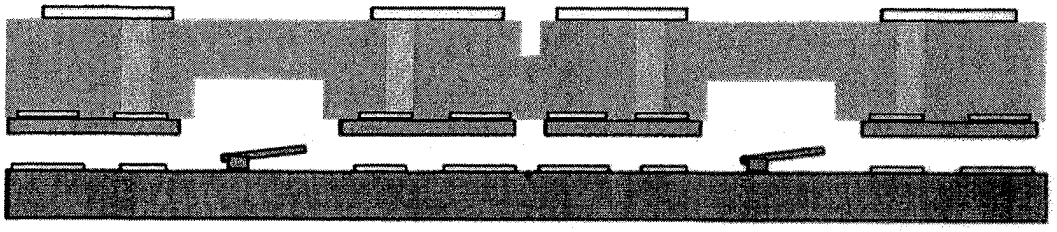


Singulation

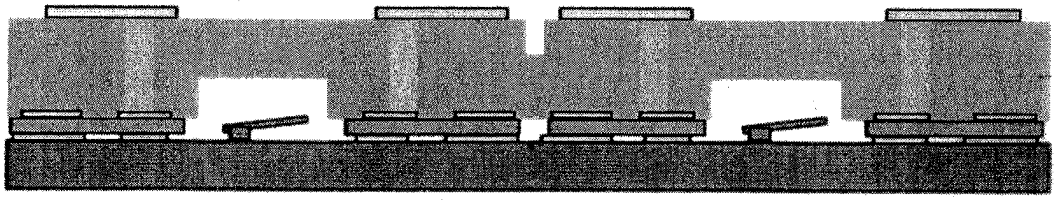
Process Flow III



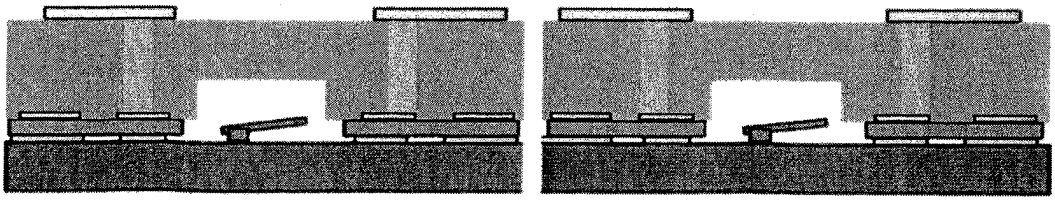
Device & Package



Anisotropic Conductive Film (ACF) attachment

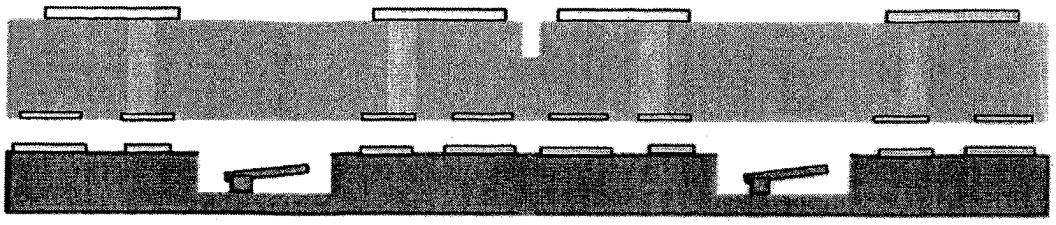


Die attach and Cure

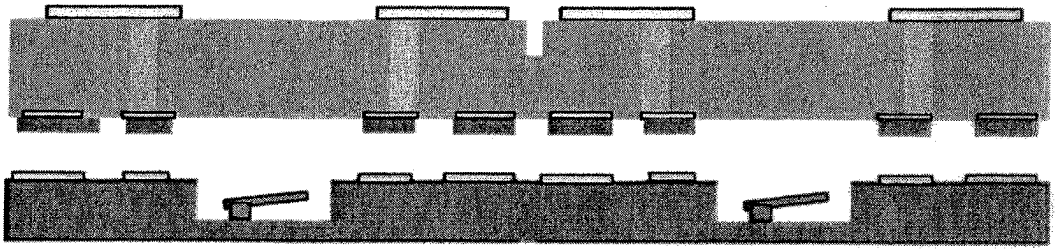


Singulation

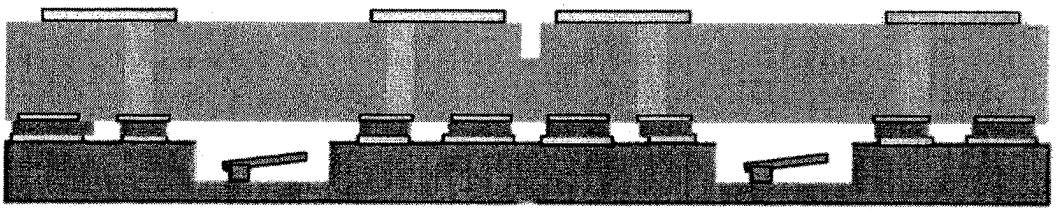
Process Flow IV



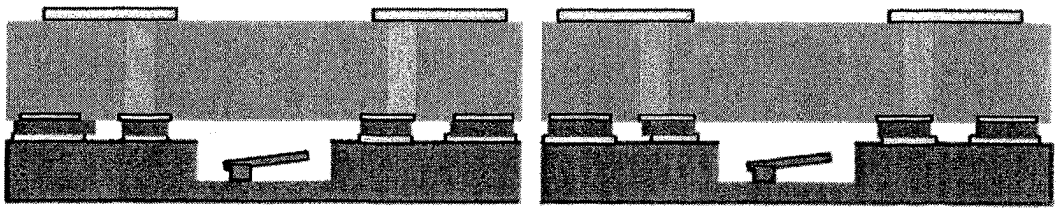
Device and package



Solder printing

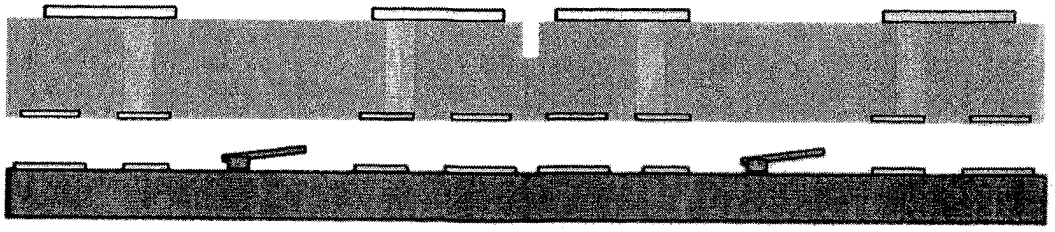


Die attach and Reflow

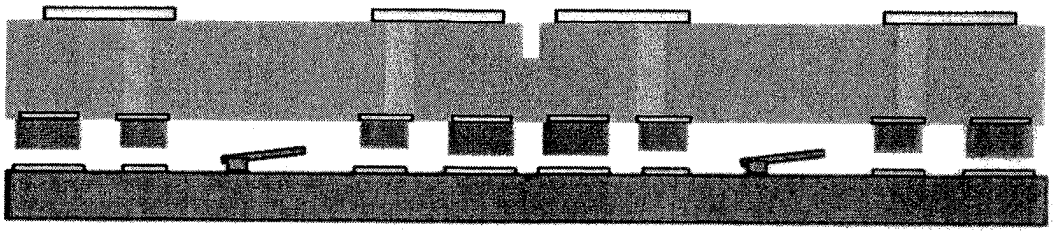


Singulation

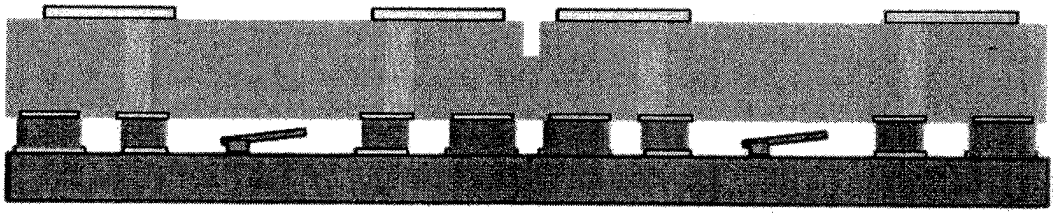
Process Flow V



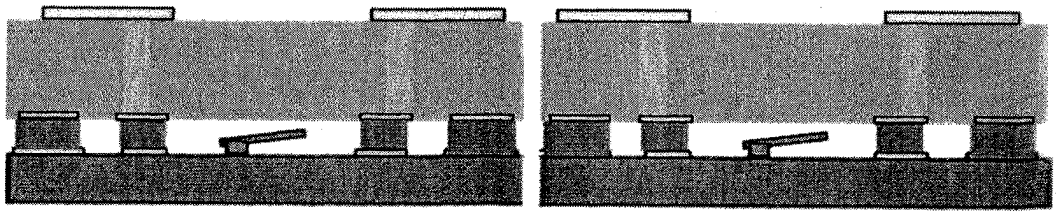
Device and package



Solder printing



Die attach and Reflow



Singulation

Wafer Level Packaging:

Advantages:

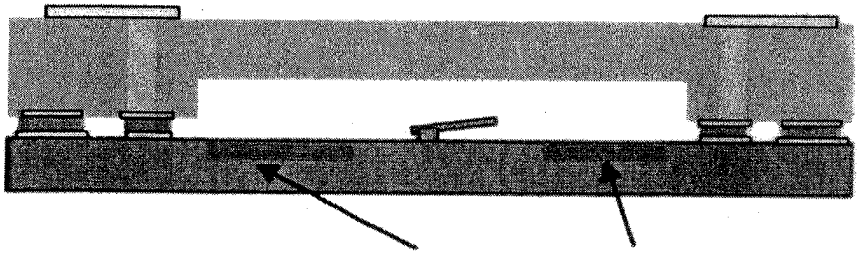
(1) Fewer process steps
(2) Much greater throughput
(3) No die handling issues
(4) Smaller package size and thickness
(5) Reduced package material cost
(6) Lower inductance

Disadvantage :

Larger die area
-less significant for integrated switch designs

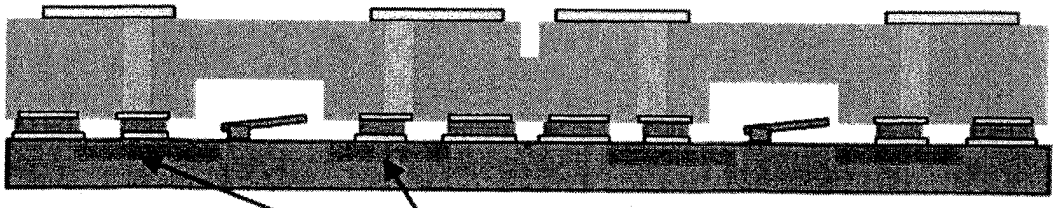
Wafer Level Packaging with Integrated Switch

W/O Bond over Devices



Control, Power Supply

With Bond over Devices



Control, Power Supply

Attachment B8

Date: June 26, 2000
To: Darrel Frear
CC: Distribution

From: Shun-Meen Kuo

Phone: (602) 413-5664

Subject: Weekly Report (6/19-6/23, 2000)

REDACTED

REDACTED

RF-MEMS Project: (AD,RL)

REDACTED

- **Patent committee decided to file the disclosure "Wafer level RF MEMS switch packaging" (#SC11259ZP).**

REDACTED

REDACTED

REDACTED

Attachment B9

BRYAN CAVE LLP

TWO NORTH CENTRAL AVENUE
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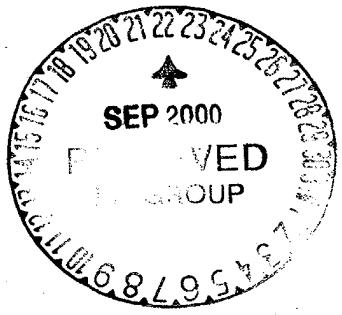
LONDON, ENGLAND
RIYADH, SAUDI ARABIA
KUWAIT CITY, KUWAIT
ABU DHABI, UNITED ARAB EMIRATES
DUBAI, UNITED ARAB EMIRATES
HONG KONG
ASSOCIATED OFFICE IN SHANGHAI

GEORGE C. CHEN
REGISTERED PATENT ATTORNEY

INTERNET ADDRESS
GCCHEN@BRYANCAVELLP.COM
DIRECT DIAL NUMBER
(602) 364-7367



September 7, 2000

VIA FACSIMILE ONLY
(480) 413-4511

Mr. Shun Meen Kuo
Motorola, Inc.

Re: Patent application for ELECTRONIC COMPONENT AND METHOD OF MANUFACTURE
Your Reference No. SC11259ZP
Our Reference No. 118278

Dear Mr. Kuo:

Please review the enclosed drawing figures 1 through 22 along with the specification previously emailed to you. Please provide me with your comments to the drawings and the specification as soon as possible.

The specification must contain a written description of (1) your invention and (2) the manner and process of making and using your invention. The written description must contain full, clear, concise, and exact terms to enable any person, who is skilled in the art to which your invention pertains, to make and use your invention. The written description must also set forth the best mode contemplated by the inventor(s) for carrying out your invention.

After the specification and drawings are finalized, you must sign a Declaration pertaining to your invention as recited in the claims of the specification. Therefore, do not hesitate to discuss the claims with me if you have any questions regarding their coverage.

According to U.S. federal law, inventors and their attorneys and agents have a duty to disclose material facts of which they have knowledge. Failure to disclose these facts may result in a

BRYAN CAVE LLP

finding of inequitable conduct and may also invalidate any patent that issues from this patent application. Material facts for your application may include any of the following:

(a) any filed patent applications, issued patents, published articles, product announcements, published technical reports, public lectures, or other materials related to your invention, in whole or in part;
(b) any public use or demonstration of products or methods that relate to your invention;
(c) any product or method over which your invention is an improvement;
(d) any related work by co-workers; and
(e) any sale, offer for sale, or sampling of products incorporating your invention or made by its use.

Please notify me of any of the above items and any other available information related to your claimed invention before the patent application is filed in the Patent Office. The pertinent facts will be presented to the Patent Office to obtain more reliable protection for your invention while avoiding the possibility of engaging in inequitable conduct.

Please sign and date this letter, indicating you have read, understood, and complied with the requirements set forth hereinabove. Please mail this letter with your original signature back to me. I am available to answer any questions you may have regarding your patent application, this letter, and your obligations as an inventor.

Very truly yours,

George C. Chen

GCC/mtr
Enclosure

[INVENTOR SIGNATURE PAGE ATTACHED]

BRYAN CAVE LLP

By: Shun Meen Kuo
Shun Meen Kuo

Date: 9/20/00

By Darrel Richard Frear

Date: 9/20/00

Attachment B10

COMBINED DECLARATION AND POWER OF ATTORNEY FOR PATENT APPLICATION

Attorney Docket

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below), or an original, first and joint inventor (if plural names are listed below), of the subject matter which is claimed and for which a patent is sought on the invention entitled ELECTRONIC COMPONENT AND METHOD OF MANUFACTURE, the specification of which is attached hereto unless the following box is checked:

☐ Application was filed on _____
as Application No. _____
and was amended on _____.

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the patentability of this application in accordance with Title 37, Code of Federal Regulations, §1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, § 119(a)-(d) or 365(b) any foreign application(s) for patent or inventor's certificate, or 365(a) of any PCT international application which designated at least one country other than the United States of America, listed below and have also identified below, any foreign application for patent or inventor's certificate, or of any PCT international application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application(s)			Priority Claimed
_____	_____	_____	☐ Yes ☐ No
(Number)	(Country)	(Day/Month/Year Filed)	
_____	_____	_____	☐ Yes ☐ No
(Number)	(Country)	(Day/Month/Year Filed)	

I hereby claim the benefit under Title 35, United States Code, § 119 of any United States provisional application(s), listed below:

_____	_____
(Application Number)	(Filing Date)
_____	_____
(Application Number)	(Filing Date)

I hereby claim the benefit under Title 35, United States Code, § 120 of any United States application(s), or 365(c) of any PCT international application designating the United States of America, listed below:

(U.S. Parent Application Number or PCT Parent No.)	(Filing Date)	(Country)
(U.S. Parent Application Number or PCT Parent No.)	(Filing Date)	(Country)

I hereby appoint the attorney(s) and/or agent(s) associated with Customer Number REDACTED to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith.

Address all telephone calls to Mr. Charles W. Bethards at telephone no. REDACTED

Address all correspondence to customer number REDACTED

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

FULL NAME OF FIRST INVENTOR: FIRST MIDDLE LAST	INVENTOR'S SIGNATURE:	DATE: (SPELLOUT MONTH)
Shun-Meen Kuo	Shun-Meen Kuo	October 3 2000
RESIDENCE: REDACTED		CITIZENSHIP: United States
POST OFFICE ADDRESS: Same as above		

FULL NAME OF SECOND INVENTOR: FIRST MIDDLE LAST	INVENTOR'S SIGNATURE:	DATE: (SPELLOUT MONTH)
Darrel R. Frear	Darrel R. Frear	October 3, 2000
RESIDENCE: REDACTED		CITIZENSHIP: United States
POST OFFICE ADDRESS: Same as above		

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:	:	
KUO et al.	:	
Serial No.: 09/684,576	:	Group Art Unit: 2827
Filed: October 6, 2000	:	Examiner: Luan C. Thai

For: ELECTRONIC COMPONENT AND METHOD OF MANUFACTURE

EXHIBIT D

STATEMENT ESTABLISHING DILIGENCE

I, Jaynal Abedin Molla, declare that:

1. I am an employee of Motorola, Inc., and am acquainted with Shun Meen Kuo and Darrel Richard Frear, the co-inventors of the above identified invention; and
2. On or about February 25, 2000, I read and understood the invention disclosure recorded on pages 41-46 of Shun Meen Kuo's inventor notebook and signed and dated pages 41-46 of Shun Meen Kuo's inventor notebook indicating my understanding of the disclosure (see Attachments B1 and B3).

Dec. 17, 2002
Date

Jaynal Abedin Molla
Jaynal Abedin Molla

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of: :

KUO et al. :

Serial No.: 09/684,576 : Group Art Unit: 2827

Filed: October 6, 2000 : Examiner: Luan C. Thai

For: ELECTRONIC COMPONENT AND METHOD OF MANUFACTURE

EXHIBIT E

STATEMENT ESTABLISHING DILIGENCE

I, George C. Chen, declare that:

1. I am an employee of Bryan Cave LLP, a law firm engaged by Motorola, Inc. to perform legal services on its behalf, including legal services in the field of intellectual property law;
2. On or about June 23, 2000, I received from Motorola, Inc. a disclosure # SC11259ZP regarding the above identified invention (see Attachment E1);
3. On or about July 11, 2000, I conducted an interview with Shun Meen Kuo and Darrel Frear regarding the invention;
4. During July, August, and September, 2000, I worked on the patent application;
5. On or about September 7, 2000, I sent a draft of the patent application for the invention to Shun-Meen Kuo and Darrel Frear for their review (see Attachment E2);

6. On or about September 25, 2000, I received comments from Shun-Meen Kuo regarding changes to the patent application, reviewed and revised the patent application accordingly, and sent the finalized patent application to Motorola, Inc. (see Attachment E3).

20 December 2002
Date

George C. Chen

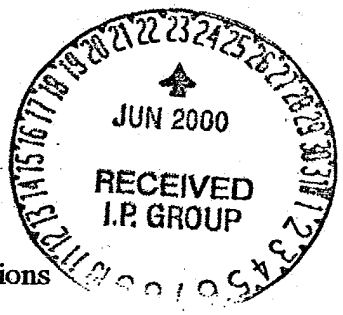
Attachment E1

MOTOROLA

Law Department

DELIVERED VIA COURIER

June 23, 2000



Mr. George C. Chen
Bryan Cave, LLP
Two North Central Avenue, Suite 2200
Phoenix, AZ 85004

RE: Preparation of Patent Applications

Dear George:

Per instructions from Charles Bethards, enclosed please find four cases for which we would like to have you prepare applications. They are as follows:

REDACTED

SC11259ZP - KUO

REDACTED

Best Regards,

Lisa Marie Hopkinson

Lisa Marie Hopkinson
Administrative Assistant

Encl.

cc: Charles Bethards

Mail Drop: AZ49 / R3163
8220 East Roosevelt Road, Scottsdale, Arizona 85257
P.O. Box 10219, Scottsdale, Arizona 85271-0219
Telephone: (480) 441-5419 Facsimile: (480) 441-5220

Attachment E2

From: George C. Chen
To: Frear, Darrel; Kuo, Shun Meen
Date: 9/7/00 1:18PM
Subject: Patent application for SC11259ZP

CONFIDENTIAL
ATTORNEY-CLIENT PRIVILEGED

Re: Your Reference: SC11259ZP
Our Reference: 118278

Shun Meen & Darrel:

Attached is a copy of your patent application. Please review it, and send me a single set of consolidated comments.

If you choose to make revisions directly to the electronic document, please use the "Revisions" function in MS Word 95 or the "Track Changes" function in newer versions of MS Word.

We will fax you a copy of the drawings for your patent application. Included in that fax is a 3 page letter. Please follow the instructions on the letter, sign the letter, and mail the original signed letter back to me.

If you have any questions, do not hesitate to contact me.

Best regards,
George

==========

George C. Chen
Registered Patent Attorney

Bryan Cave LLP
Suite 2200
Two North Central Avenue
Phoenix, AZ 85004-4406

Tel: (602) 364-7367
Fax: (602) 364-7070

Email: gcchen@bryancave.com
Web Site: http://www.bryancave.com

==========

message completely from your computer system. Thank you.

Attachment E3

ST. LOUIS, MISSOURI
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NEW YORK, NEW YORK
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OVERLAND PARK, KANSAS
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KUWAIT CITY, KUWAIT
ABU DHABI, UNITED ARAB EMIRATES
DUBAI, UNITED ARAB EMIRATES
HONG KONG
ASSOCIATED OFFICE IN SHANGHAI

INTERNET ADDRESS
GCCHEN@BRYANCAVE.COM

September 25, 2000

VIA FEDERAL EXPRESS

Ms. Lisa Hopkinson
Motorola Inc.
8220 East Roosevelt
Building 3, MD R3163
Scottsdale, Arizona 85257

Re: U.S. Patent Application
Title: ELECTRONIC COMPONENT AND METHOD OF MANUFACTURE
Your Reference No.: SC11259ZP, Kuo
Our Reference No.: C16699.118278

Dear Lisa:

Enclosed please find an original U.S. patent application for "ELECTRONIC COMPONENT AND METHOD OF MANUFACTURE" together with a disk containing the application in both "word" and "rich text" formats, and informal drawings (FIGs. 1-22). In addition, the inventor has identified the following references: U.S. Patent Application No. 09/495,786 (Motorola Docket No. SC10698T, Huang) and U.S. Patent Nos. 5,323,051; 6,064,114; 6,008,070; 5,946,555; 5,940,683; 5,915,168; 5,904,555; 5,798,557; 5,593,903; 5,519,193; 5,478,781; 4,920,454; 4,811,082; and 4,193,083.

A Pro Forma Invoice for this application is also enclosed.

Please do not hesitate to contact us with questions or comments or if we can be of further assistance to you. It has been a pleasure working with Motorola in the preparation of this patent application.

Very truly yours,

BRYAN CAVE LLP

George C. Chen

GCC/mtt
Enclosures